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Electron paramagnetic resonance and electron nuclear double resonance study of the paramagnetic complexes of anthraquinone on the surface of γ-Al2O3

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Abstract

Progress in the synthesis and applications of nanomaterials including nanocatalysts demands a use of precise analytical tools for their surface characterization. Continuous wave (cw) and pulsed electron paramagnetic resonance (EPR) techniques, including electron-nuclear double resonance (ENDOR) have been applied to study paramagnetic complexes formed by adsorption of 9,10-anthraquinone (AQ) as probe molecule by the surface of γ-Al 2O3. Up to three different paramagnetic complexes (11-line pattern and two single EPR lines) could be separated in our experiments. Their spectroscopic characteristics are extracted. It is shown that at very high concentration (ca. 10 wt %) of AQ, the obtained EPR signal is close to the single line and can be incorrectly interpreted as due to the EPR signal of AQ itself or due to the lower catalytic activity of the investigated surface. That fact should be taken into account by using AQ as a probe of the surface catalytic activity. Mims and Davies ENDOR experiments confirm the redistribution of the electron spin density between the ring protons of AQ, aluminum nuclei in AQ-Al2O3 complexes, and remote proton and aluminum nuclei with AQ concentration. The corresponding electron-nuclear distances are extracted. The presented results can be used to expand the application of AQ as a sensitive probe for the catalysts surface characterization.

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